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(U) THE DEVELOPMENT OF WEAPONS FOR  
PSYCHOLOGICAL WARFARE

by

Frederick W. Obitz  
and Wallack M. Cord

October 1964

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(U) THE DEVELOPMENT OF WEAPONS FOR  
PSYCHOLOGICAL WARFARE

by

Frederick W. Obitz  
and Hallack McCord

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FOREWORD

These studies were performed over a one year period. The literature search on photic flicker and auditory stimuli was performed by Frederick W. Chitz, who also wrote the Introduction, the Laboratory Experiments, and the Conclusions and Recommendations of this report. Hallack McCord performed the literature search on suggestion and wrote the Group Experiments portion of the study. William Orr developed the psychomotor compensatory tracking system and designed the instrumentation circuitry. David Metcalf interpreted the EEG tracings. Harry Arons contributed to the literature search on photic flicker and suggestion, and he and Irwin Marlin conducted the exploratory studies reported in Appendix II under the Irvington Lab heading.

Appreciation for the leadership and support of Arthur M. Krill, President of Falcon Research and Development Company, should certainly be expressed.

This report was prepared by the Falcon Research and Development Company, Denver, Colorado under Contract No. AF 08(635)-3635, Project No. 2911. The manuscript was completed in August 1964.



CONFIDENTIAL ABSTRACT

The purpose for this research was to investigate the potential of flickering light, sound, and suggestion, singly and in combination, for use in psychological weaponry. A search of the pertinent literature was performed followed by individual and group experimentation. The results obtained demonstrate that potential exists for the use of photic flicker as a weapon. Suggestion was effective in the laboratory but ineffective with military groups in an unemotional setting. Further experimentation with photic flicker singly and in combination with suggestion is warranted. Recommendations for further specific research are provided.

This report has been reviewed and is approved for publication.

*Noble E. Brown*  
for DAVID K. DEAN  
Colonel, USAF  
Chief, Weapons Division

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### INTRODUCTION

This document reports investigations on the effects of visual, auditory and psychological stimuli, or any efficacious combination of these, for potential use in psychological weaponry. The study began with a search of the literature, followed by experimentation with individual human subjects in the laboratory and experimentation with small groups of military subjects in the field.

The major objective of the study was to identify methods for producing maximum deleterious effects upon enemy forces by subjecting them to psycho-physiological stimulation, and to enhance and spread these effects by psychological manipulation.

For example, dependent upon the methods and intensities used, studies reported in the literature revealed that approximately five per cent of the normal population reacts to intense flickering light with epileptic-type seizures. Should five per cent of an enemy force react to photic stimulation with seizure activity, panic could spread to other members of the force, causing incapacitations and disruptions far in excess of the five per cent initially rendered ineffective because of seizures. Further, if panic behavior were intensified by the addition of auditory stimulation such as interrupted sounds, white sound, or the human voice, the cumulative effects would be more devastating than any of these stimuli delivered singly. These hypotheses were tested with individual human subjects, to the extent permitted by time and funds, during the course of this study.

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### LITERATURE SURVEY

To analyze in detail the experimental methods, techniques, and instrumentation used by other experimenters, a survey of the literature was made. The survey was largely concentrated in three areas. These included photic stimulation and visual stimuli, auditory stimuli, and the effects and possible uses of suggestion. All evidence of deleterious effect was noted.

Considerable material had to be scrutinized. Most of the studies published dealt with diagnosis and treatment of pathological conditions. Additionally, many experimenters are probably reluctant to publish data or experiences in which subjects suffered harm or incapacitation. Still, the evidence in each of the three areas was that considerable potential exists for adaptation to psychological weaponry.

#### PHOTIC FLICKER:

The approach and purpose in this project for the study of human reaction to photic stimulation was to determine whether flickering light could be employed as a weapon against enemy populations.

That the human brain produces electric currents was discovered in 1875 by R. Caton. F. von Marxow in 1893 discovered that these currents could be changed in the visual area by optic stimulation. Hans Berger (1929) began the work that led to development of the modern electroencephalogram. He measured and distinguished between what he called brain waves of the first order, occurring at 10 to 15 cycles per second, and waves of the second order, occurring at 20 to 32 cycles per second. He later renamed these alpha and beta waves, respectively. Berger's work did not attract much attention outside Germany until 1934 when Adrian (Adrian and Mathews, 1934) confirmed the existence of the electroencephalogram in the United States. This initiated a large amount of research work in many countries. Improvements in interpretation of brain wave patterns and in instrumentation rapidly followed.

Walter, Davey, and Shipton (1946) in early studies on photic driving, the changing of spontaneous brain waves to synchronize with externally delivered light flashes, precipitated some seizure activity in their subjects.

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Cobb (1947) suggested that flickered light might provoke seizures in individuals with convulsive disorders, and this has been verified by numerous investigators. Photic stimulation equipment has since become standard for the modern EEG laboratory. Producing seizures in the laboratory is useful in providing neurologists with an opportunity to observe seizure activity, and it aids in the diagnosis and treatment of some types of epilepsy.

Much of the original pioneer work with photic driving, including stimulation, and measurement and interpretation of results was done by Walter (1953) whose book generated considerable interest and further innovations by other researchers both in experimental methods and measuring instrumentation.

Walter reported that it was not necessary to obtain "exact" synchronization but that the responses noted can occur when the flicker is within 10 per cent of the subject's brain wave frequency. Among the responses thus produced were "strange feelings" and faintness or swimming in the head; some subjects became unresponsive or unconscious for a few moments; in some the limbs jerked in rhythm with the flashes of light.

Since the results of the laboratory experiments were first reported, many accounts of untoward effects have been received. These show definitely that, far from being laboratory curiosities, reactions of vertigo and epilepsy can occur by accident when an individual is exposed to the necessary conditions. In his book, Walter gives the report of an Amsterdam correspondent verbatim:

"I was still in the army and my driver and I were driving home one day through an alley of trees in bright daylight. As I was tired, I relaxed in my seat and closed my eyes. The sunlight that came through the trees played on my face, when suddenly I was aware that I had made some violent motions and woke up with one hand firmly on the windscreen--and this had prevented me from falling off the jeep. I was very puzzled and the next time we drove through this alley I tried the experiment all over again, but now I was all set for it. Now I could close my eyes but a very little while, and I knew that if I kept on, I would lose control. When I looked straight ahead, however, it did not bother me, except that I felt a bit queer and always seemed to try to avoid the flickering light of the trees, which I did with my hands before my eyes."

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In another case a man found that, when in the movies he suddenly felt an irresistible impulse to strangle his neighbor. He never actually did harm anyone, but once "came to" with his hands around his neighbor's throat. The subject of the film had nothing to do with the impulse, which seemed to occur if he moved his head suddenly while the film was on. When experimented upon with stroboscopic flicker, he developed violent jerking of the limbs when the flash rate was up to 50 per second—that is, about the flicker rate of the film projector.

Another subject "passed out" for an instant on a number of occasions while cycling home on fine evenings down an avenue of trees. In this case, the slackening of his control had slowed down his pedaling, thus changing the flicker rate appreciably, with a resulting rapid recovery.

One Falcon research scientist knows of a teenage baton twirler who goes into a convulsion every time the light strikes her spinning baton at the wrong frequency.

Time magazine (Sept. 21, 1962) reported that British physicians are seeing cases of seizure which accompany the viewing of television. Of fourteen persons seen by the doctors, only five had a previous history of epilepsy. Also, of the fourteen patients commented on, nine had seizures only while watching television. The fact that this phenomenon occurred in Britain is significant, since a flicker rate of the British TV picture fairly closely approximate the rate known to induce seizures. Another reference, Bower and Pantelakis (1962), deals with somewhat the same topic.

Much of the evidence regarding the deleterious effect of flicker has been advanced by Air Force and civilian flyers. "Flicker vertigo" has become a familiar term among pilots, and a number of reports have been published.

One of the most complete reports appeared in the MATS FLYER of April, 1956. An unsigned article by a pilot engineer gives several instances of flicker vertigo experienced by the author and includes his account of several experiments to test the occurrence of the phenomenon.

Major Charles A. Perry, Chief of USAF's Department of Flight Medicine, at Randolph Air Force Base, Texas, reporting to the Aero Medical Association at a national conference held in Los Angeles on April 27, 1959, cited several dramatic examples of grand mal, major epilepsy, induced by flicker:

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A B-36 tail gunner was suddenly seized by convulsions. The last thing he remembered was scanning the engines and seeing the sun through slowly-turning propeller blades.

In another case, a pilot serving as airdrome officer was meeting an incoming C-54. While standing on the ramp waiting for engine shut-down, he suddenly was seized by a grand mal convulsion. The last thing he remembered was noting the rays of the setting sun through the revolving propellers.

In both instances, the seizures were reproduced in the laboratory by flicker stimulation at 10, 12, 14, and 16 cycles per second.

Scholer Bangs, in an article published in the July, 1959, issue of THE PRO'S NEST, reported that he was a passenger in a helicopter on a bright spring morning when he became aware of "flitting black-barred shadows of the rotor blades" as the pilot swung into a new heading at about 2 o'clock high. Almost instantaneously a "violently-pulsing, red cloud" destroyed his vision and he was seized by "excruciating, uncontrollable panic." He struggled to get out of the plane--500 feet above a green meadow--but his safety belt held. The startled pilot immediately banked and headed for home base; and the passenger immediately recovered. This occurrence, too, was repeated experimentally, again with sudden onset and sudden recovery as the subject was exposed to and shielded from the stimulus.

The "red cloud" reported by Scholer Bangs has been mentioned by other investigators. Dr. John T. Flynn, writing in THE PRO'S NEST of January, 1962, reported that the intensity of the light source as well as its color has an effect on what he calls "flicker unconsciousness". He says that "bright light of a single color has been found to be about one and one-half times more effective in causing flicker unconsciousness in susceptible individuals than neutral white light of the same intensity." While all the colors of the spectrum have not been tested, Dr. Flynn reports that blue and orange-red are more likely to cause trouble, especially the latter. He also says that when the eyes are closed while exposed to an intense white light, it is still perceived as red or orange through the closed lids. This may explain why closing the eyes does not prevent reactions to flicker, but may actually accelerate them.

The case of Joel Thorne, a wealthy Los Angeles pilot, brings another aspect of flicker into focus. Thorne took off from

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Lockheed Air Terminal on a stormy night, flying a low-wing, single-engine plane. His plane was seen to enter low-hanging clouds several times and then come hurtling down in tight, diving turns from which he barely recovered above North Hollywood roofs. But this last dive and pull-out tore a wing from his plane, which crashed and burned. Since Thorne had had numerous brushes with CAA officials over erratic flying, this was immediately assumed to be the cause of the accident.

But two Civil Aeronautics Board investigators were not satisfied as to what caused Thorne to lose control of his plane seven times in succession. On a hunch, they rented a plane identical to Thorne's and equipped it with an anti-collision light mounted at the same forward location on top of the fuselage as a light on Thorne's plane. They waited for a night with low dirty clouds and an overcast similar to the one existing when Thorne crashed.

In reviewing Thorne's crash findings the CAB investigators said they experienced "serious vertigo" as the rapidly rotating beams of the anti-collision light gave a whirling illumination of clouds enveloping the plane. They found that their only escape from vertigo was to dive out of the clouds as Thorne had done.

Research by Beech Aircraft Corporation has caused them to issue warnings of the effects of rotating anti-collision beacons on both the top and bottom of single-engine planes flying in clouds. Flight tests with a single-engine Bonanza have revealed the possibility of causing "distractions, discomfort, and vertigo" which "could be disastrous" for a pilot with little or no instrument flight experience and "extremely hazardous" for an experienced and proficient instrument pilot.

That photic flicker can trigger seizures and other adverse effects among human and animal subjects is therefore well established in the literature. Lennox and Lennox (1960), authors of the accepted classic in the treatment of epilepsy, state that all individuals possess a seizure threshold and that degree of seizure proneness is the variable, not presence or absence. These authors also contend that the seizure threshold is often lowered by birth injury or high fever in childhood. This contention is supported by numerous case histories. It follows that in countries where physician-attended births are uncommon and where childhood diseases are not generally treated by competent medical practitioners, the seizure thresholds of the

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general populations would be lowest. Lennox and Lennox accept the incidence of epilepsy in the United States as being one-half of one per cent, a figure arrived at by study of World Wars I and II draftee incidence. The figure estimated for Switzerland was approximately one per cent. In countries with lesser developed medical treatment this figure increases. Driver (1962) found that 75% of his experimental epileptoid group evinced convulsions when exposed to photic flicker.

Photic flicker evokes seizures in individuals who have never previously experienced an epileptic attack. Watson (1960) in a study of 100 helicopter pilot trainees for the U. S. Army found clinically significant abnormal EEG responses among 5 per cent when exposed to photostimulation. These trainees had been subjected to rigorous physical examination prior to entering into the helicopter pilot training program. Lennox-Buchthal, Buchthal and Rosenfalck (1960) found that 6.9 per cent of successful applicants for pilot training in the Royal Danish Air Force during the period 1951-1955 were seizure susceptible when subjected to laboratory photic flicker. Brandt, Brandt, and Vollmand (1961) studied the response of 120 subjects, mainly of school age with none over the age of 15. Various flicker frequencies were used at intensities from about 25,000 to 100,000 foot-candles. Seizures were precipitated in 25.8 per cent. They concluded that the human brain, when not fully mature, is more susceptible to seizure response with photo-stimulation than the mature adult brain.

DeArellano and Windle (1961) report the accidental death of four monkeys which developed status epilepticus (continuous massive seizures) during exposure to intense photic flicker beginning at one and increasing to eighteen cycles per second. They presented the photo-stimulation at three inches from closed eyes.

Ulett (1953a) reports on a study conducted with 306 subjects who were subjected to photic flicker at rates varying from 3 to 33 cycles per second and at an intensity of 300,000 foot-candles. Sixteen or 5.2 per cent of their subjects had disturbance of consciousness, fainting, syncope or convulsions. This figure closely parallels the findings of Watson (1960) and Lennox-Buchthal, Buchthal and Rosenfalck (1960). In addition, Ulett found that 87 or 28.4 per cent, responded with nausea, headache, or feelings of movements in space. Two physicians working in the laboratory reacted severely. One developed nausea, dizziness, and confused thinking, together with reading

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and speech difficulties. The other developed chronic gastro-intestinal symptoms which would come and go as his exposure to photic flicker varied. These were persistent and not transient effects.

In another study, Ulett, Gleser, Starr, Haddock, Lingley, and Lawler (1953) found a significant correlation between anxiety proneness and the amount of dysphoria produced by flicker. This finding may indicate that the incapacitating power of flicker would be enhanced when used under battlefield conditions of stress.

Carterette and Symmes (1952) reported that the color of flicker is an important variable in the production of abnormal EEG responses. In an experiment, carefully controlled for intensity, they found red to be the most effective, followed by green, blue, and white, in that order. Wratten gelatin filters numbered 24 (red), 74 (green) and 75 (blue) were used. Substantial differences were measured. Stimulation was presented with the eyes open to avoid having the closed eyelids act as a red filter. They further report that two of the photogenic epileptic patients they examined were benefited spectacularly from the use of glasses that eliminated the red end of the spectrum.

The use of extremely rapid paired flashes of stroboscopic light has also been used (Schwab, et al 1955). The rationale for use is that optic neural pathways would be more receptive to maximum stimulation during the second of the paired flashes. Overall effectiveness of paired flashes, though, was not significantly greater than those delivered singly.

Numerous other studies deal with responses to photo-stimulation by various diagnostic groups such as neurologic disease (Wells, 1960), (Schwab, England, and Gray, 1955); brain disorders (Boldyreva, 1962); schizophrenia (Hein, 1962); depressive psychoses (Wilson, 1961); brain tumors (Bechtereva, 1962); chronic alcoholism (Strel'chuk and Melekhova, 1962); and with self-induced epilepsy (Chao, 1962). These are of interest in that they confirm that the incidence of seizures in response to photo-stimulation increases as the health of the population decreases. Methods of instrumentation are also of interest.

Not all studies with photic flicker report seizure activity on the part of their subjects. Alexander (1960) reports little effect on subjects who were exposed to two and one-half hours

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of photic flicker. Four General Radio Strobolux lamps were used simultaneously with lamp no. 1 flickering alternately at 10 and 15 cps, no. 2 at 10 cps, no. 3 at 5 cps, and no. 4 at 15 cps. The total peak intensity was 350,000 candle power. Two and one-half hours of photic stimulation did not increase the subjects susceptibility to flicker.

Bach (1957) in his three-year study for the Army, and ending with the Tulane Symposium on Flicker, obtained essentially non-incapacitating results. His experiments used frequencies from 6 to 24 cycles per second, but used a fixed frequency with each subject. No variations in color were attempted, but one experiment varied the light-dark ratio. Flicker at nine cycles per second and with a light-dark ratio smaller than 1:3 was found to be most disturbing in terms of subjective responses. Some degree of drowsiness was reported by all subjects who experienced this stimulation.

Remond (1964) reports on a technique he has developed over the past ten years for production of spacial-temporal maps, representing cortical activity during exposure to photic flicker. Graphic evidence of EEG signal activity is obtained by computer analysis both as a function of time and as a function of the topographic distribution of the phenomena in relation to experimental conditions and events.

Cortical and subcortical events occurring between stimulus and response have been rather fully covered in Whipple (1964). This volume and its supporting bibliographies represent present knowledge of the neurophysiology associated with evoked responses to photic stimulation.

Automatic, frequency, and computer analysis of EEG signals is located in Brazier (1962).

### AUDITORY STIMULI:

The initial literature survey on auditory stimuli was directed toward seeking broadly the types of stimuli which may inflict incapacitating or disabling effects upon an enemy population. Excluding focused ultrasound, which comprises a separate research area, the field was narrowed to auditory flutter and white sound.

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### Auditory Flutter

The literature uncovered using auditory flutter or square wave sound was not extensive.

Vor Sheller (1932) found that by presenting photic flicker and auditory flutter concomitantly the brightness of the flicker was enhanced.

This phenomenon was verified by Knox (1953, 1957). Knox also investigated the CFF (Critical Fusion Frequency) of flickering light presented with silence, continuous sound stimulation and fluttering sound. No significant differences in CFF were found under these various sound conditions. Knox concluded that auditory flutter cannot produce flicker when not already present, i.e. above CFF, but that auditory flutter increases the pronouncedness of photic flicker when it is already present.

Neher (1961) reports on the lack of success in obtaining evidence of alpha driving in the EEG tracings of subjects stimulated with pure sounds fluttered in the alpha range. He did obtain driving by recording a complex sound, beating a snare drum with the snare released, and fluttering this sound in the alpha range.

Teichner, et al (1963) in a paper on sound distraction gives evidence that at all sound ratios, performance in noise is better than in a condition of silence. They suggested further research using a distraction-arousal model.

### White Sound

An interesting literature has recently developed with respect to white sound.

Cook (1960) differentiated between white noise and white sound. White noise is the simultaneous presence of all frequencies of noise in the audible spectrum in equal intensity. White sound is derived from the precise tailoring of white noise to match the sensitivity versus frequency characteristic of the ear. He stated white sound is capable of producing uniform and high degrees of stimulation over a large fraction of the 30,000 auditory nerve endings distributed along the basilar membranes of the inner ear. Cook further stated that white sound, properly delivered, acts as a catalyst to hypnosis.

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White noise has been used for some time by psychologists in controlling the intelligibility of noise stimuli. Other types of noise may be intelligible, that is, they may have some experiential meaning for some subjects.

Zacks and Freedman (1963) reported that the abilities of subjects to perform an auditory localization task deteriorated after one hour of listening to dichotic white noise, but only if they were actively moving about. Similar exposure to the noise while the subject was passively moved about in a wheelchair by the experimenter had little if any effect on auditory localization. Exposure while active had an adverse effect while exposure while passive did not.

Freedman and Pfaff (1962) published similar findings. In their experiment subjects were first tested on ability to distinguish time differences of a pair of clicks delivered to the ears by earphone. Delay between signals to the two ears was variable from 5 microseconds to one millisecond. Ambulatory subjects exposed to two hours of continuous dichotic white noise suffered a loss of ability to discriminate time differences; those exposed to the same noise stimuli while lying still on a bed did not give evidence of discrimination deterioration.

The bulk of the research reported on white sound deals with its use in dental operations. The method of delivery is via stereophonic earphones and mixed with music. This method is called audio analgesia. Licklider (1964) believes there has been no serious work in the delivery of white sound without the use of earphones. He indicated his own work using loud-speakers rather than earphones was exploratory and not conclusive.

Gardener and Licklider (1959) reported that through use of the Audio Analgesiac, effective analgesia was produced in 63 per cent of 387 dental patients who previously had required a local anesthetic or gas. They also reported that extractions were made on 119 patients, using only the Audio Analgesiac for anesthesia.

Gardener, Licklider, and Weiss (1960) in a later study with 5000 dental patients of 9 dentists stated that audio analgesia equipment was fully effective in 90 per cent of the cases. One dentist extracted over 200 teeth using no other anesthetic without encountering any difficulty or report of objectionable pain.

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Davis and Glorig (1961) gave minimum apparatus requirements for audio analgesia and the limits of intensity for safe usage.

Several other investigators have been unable to duplicate these results in dental type situations. Carlin, et al (1962) tested dental patients with a vitalometer while they were being administered white sound. The vitalometer tingle was not cancelled. Robson and Davenport tested 13 subjects with a thermal stimulus during exposure to white sound and failed to obtain any significant alteration in pain threshold.

Pishkin and Hershisier (1963) using Cook Laboratory white sound and music records reproduced on a stereophonic speaker system found it to be a noxious stimulus to their subjects.

### SUGGESTION:

Suggestion elicits action through communication addressed to feeling and emotion. Bird (1940) points out that suggestion operates to restrict critical thinking through selected emphasis without investigation of the assertions made by the suggestion. He differentiates between direct and indirect suggestion on the basis of whether the recipient can perceive the suggestor's aim as well as the mode of presentation. In direct suggestion the recipient is aware of the intentions of the suggestor. In indirect suggestion the aim is camouflaged and the subject is often manipulated into believing that self motivation or other causes are responsible for his actions.

Another kind of suggestion, auto-suggestion, is possible because individuals have experienced language and symbolic processes in connection with somatic occurrences. Thus a person may talk to himself and secure much the same kind of result as suggestion delivered from external sources. Sensory and memory processes when conditioned and aroused may initiate irresistible desires to carry out self-suggested acts.

Important components of suggestion include the use of partial aspects of situations previously effective only in their totality, the constellations of habits, wishes, strivings, and experiences of the recipient, particularly those involving emotional components, and the motivation lying behind the suggestion.

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Suggestibility is heightened in hypnosis, in states marked by intense feelings of prolonged emotion and in excited states and by the use of alcohol and some drugs.

As to the effects of suggestion, including the effects of suggestion produced by hypnosis, an examination of the literature reveals many possibilities for application in psychological weaponry. Suggestions, both accidental and purposeful, have been responsible for a variety of deleterious and disruptive behavioral acts. These range from simple incapacitation and lowering of efficiency to the apparent production of death. Suggestion has modified the behavior of individuals, groups, and masses.

To cite but a few examples, Rawcliffe (1959) discusses "thanatomania", a term denoting that suggestion, intense expectation, fear, and severe anxiety may, among primitive communities, produce a coma resulting in death. Rawcliffe also refers to death by suggestion elsewhere in his book.

Barber (1961) is critical of the notion that suggestion alone may actually be a cause of death. He does concede that a member of a primitive population might be so readily influenced by suggestion that he would simply give up hope, go home, and starve himself to death. Either way, the end result would be the same.

Le Shan (1962) provides a historical account of death by suggestion and cites other references where the phenomenon is discussed. He points out that in early times many people believed in the possibility of death by suggestion.

Cannon (1942) discusses instances of "voodoo death" occurring in human beings and Richter (1957) deals with death proneness being "suggested" into rats.

Regardless of the view that one takes about the power of suggestion to produce death, there is no doubt that suggestion, either deliberate or accidental, has produced severely incapacitating effects in some persons and groups. Ingenious application certainly can convert some of these reported deleterious effects to military use.

For instance, as recently as May, 1961, Rankin and Philip (1961) report on an "epidemic of laughing" that incapacitated a good many persons in the Bukoba District of Tanganyika. The authors indicate that "No fatal cases have been reported". They



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say, however, that symptoms lasted from several hours to a maximum of sixteen days. They indicate that, although the condition requires further study, it probably results from mass hysteria in a susceptible population.

More recently this epidemic has died out in Tanganyika but has erupted in Uganda near the Congo border.

In dealing with the historical background for their conclusion, Rankin and Philip cite several cases which are pertinent here. Among these is the case of the woman factory worker who suffered convulsions for 24 hours after a mouse was dropped down her neck (fear effect); the religious revivalists in Kentucky who became so fearful of the future that some "took to barking like dogs".

Rawcliffe (1939) also reports on "jumping disease" occurring in the Malayan States. (This was also reported as occurring among early day woodsmen in New England.) Jumping disease was manifest by ejaculations and violent movements following the actions (suggestions) and words (suggestions) of other persons. Apparently in the above Malayan society it at one time was considered amusing to hypnotize a person and suggest to him that he was a civet cat. This done, the individual would get down on all fours, stalk barnyard chickens, and eat their raw flesh.

Mason (1960) indicates that Rasputin apparently used indirect suggestion to render those who sought him out more susceptible to his suggestions. It is alleged that Rasputin kept a corridor of hypnotically-controlled "living statues" outside his chambers. These cataleptically-entranced persons offered strong suggestions as to the powers of Rasputin to visitors who might be skeptical of him.

Harris (1957) discusses "saka" -- cases of hysteria occurring in a Kenya tribe. Saka, which attacked only women in this society, resulted in fits of shaking, convulsive movements, and speaking strange sounds. Likely the occurrence of saka resulted from some form of societal suggestion.

Belo (1960), in discussing trance behavior in Bali, points out that many, on ceremonial occasions, will spontaneously go into a trance, suffer convulsions, dissociation, anesthesia, and amnesia. Others would become hysterical, fall limp, become rigid, suffer crying spells, and talk in an unknown tongue.

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Some of the entranced persons would attack their own breasts with a sharp dagger. Perhaps this may be likened to the amok psychosis at one time occurring in Malaya.

The above tends to indicate to some extent the role suggestion may have played and can play in less sophisticated societies. Modern-day societies, however, perhaps are no less susceptible to appropriately placed suggestions. Examples of suggestion working in modern times in the U.S.A. include the 1938 Orson Welles "Invasion from Mars" scare and the "Phantom Anesthetist of Mattoon" fiasco.

It should be stressed here, too, that direct contact with a person under certain conditions is not a requisite to trance induction. McCord, among others, has succeeded in hypnotizing subjects rather readily over the telephone. Rawcliffe points out that on a closed-circuit British Broadcasting Company television show, two TV engineers were hypnotized so deeply that they required the presence of the hypnotist in the flesh to de-hypnotize them.

Also, it is not necessary under certain circumstances, for a person to know he is being hypnotized or even to consent to it. McCord (1964) readily has induced hypnosis in persons who were engaged in reading a book. Although some of these actively tried to resist trance induction, a good proportion went into hypnosis anyway. One subject tried to resist entrancement by trying to look up telephone numbers while attempts were made to hypnotize him. He was able to look up only three numbers, however, before becoming too deeply hypnotized to continue his search of the phone book.

McCord also sought to hypnotize a twenty-year-old female subject who was copying a letter on the typewriter. Although she tried to resist, she closed her eyes in about three minutes, finished the sentence she was typing from memory, and then was unable to continue typing at all. Watkins (1949) reports the case of a subject who was unable to resist trance induction even though she was offered a sum of money if she could.

In any event, there seems no question that aptly used suggestion could play an important role in the area of psychological weaponry. The effectiveness of any suggestion, however, would depend to considerable extent on how closely it tied in with the religion, superstition, and general culture of the community under concern.

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Thus, some communities would be ripe for one form of suggestion and others for another. Because of this existing "ripeness," for instance, Yugoslavians experiencing a severe earthquake in the summer of 1963 were sure World War III had broken out. They were convinced that war was imminent and selected out of the suggestion (earthquake) the substantiation for the thing they were ready to believe.

For other examples of readiness to accept suggestion, shortly after the close of World War II, a sewer exploded in Brooklyn. People ran screaming into the street, believing the Russians had dropped the atom bomb. Also, in Denver, Colorado, a few years ago, a disk jockey suddenly interrupted his program with the announcement, "Don't panic! Don't panic! We've just had a report there's an amoeba loose in South Denver!" Needless to mention, the police department switchboard was jammed with calls from persons wanting protection from the strange, unknown creature.

In the above instances, each "society" was ready in its own individual way to be reached by and respond to the suggestions given. It no doubt is true that every society has readiness factors which can be tied in with to make it susceptible and reactive to certain forms of suggestion.

Practically every writer on mob panic behavior points toward direct or indirect suggestion as a major causal factor. Brown (1954) agrees with this contention.

Previous research on the production of panic has taken two emphases. These are the relationship of factors within the individual and the relationship of outside factors.

Strauss (1944) has summarized the first of these factors as they relate to military action. He contends that individual factors in panic are: 1) Those that physically weaken men like intoxication, bad health, poor nourishment, or fatigue; 2) Those that lessen their mental ability, such as confusion, doubt, and uncertainty; 3) Those that produce high emotional tension and heightened imagination like anxiety, feelings of isolation and insecurity. It appears that this grouping has omitted group and cultural factors. Not all starved troops panic and some well-fed troops do. Leaderless and starving Japanese troops did not surrender during World War II.

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Research is required on how to trigger panic, mass hysteria, and other incapacitating effects in enemy populations through the predictable and controlled use of suggestion. That it can be done is established. How it can be induced and to what extent by what stimuli in specific cultures is not known.

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### LABORATORY EXPERIMENTATION

The literature search suggested a plethora of potential experimental variables requiring careful control. These included intensities of flicker, frequencies of flicker, light-dark ratios, color of flicker, types of sound, intensities of sound, and types of suggestion. All of these, if tested singly and in combination would require a vast number of experimental conditions and more time, experimental subjects, and funds than programmed during the project period. Variables, therefore, had to be severely delimited. This was accomplished, in part, by exploratory and pre-experimentation as reported in Appendix II. Selection of variables was accomplished on the basis of those essential to test the major hypotheses.

In keeping with goals of practical application, methods of applying the experimental stimuli were restricted to conditions that could be delivered in the field. Thus, white sound, on which detailed laboratory data is available, and which has proven effective in dental operations when delivered via stereo ear-phones, was presented through loud-speakers at a maximum ambient level short of causing permanent hearing damage to experimental subjects. Flickering light was presented at maximum intensities short of causing permanent eye damage (burning of the macula) to experimental subjects and without diffusion even though it was known that light diffused very near the eyes by means of opal glass or half ping-pong balls gives more effective results in the laboratory.

#### METHOD:

##### Experimental Subjects

Sixty-four subjects were obtained from the Colorado State Employment Service. The only pre-selection criteria were that subjects be males over 21, not more than 30 years of age, and not university graduates. A confidential medical history was obtained to prevent admitted epileptics and individuals with organic brain damage from participating. Cattell's Sixteen Personality Factor Questionnaire, Form C, was administered to eliminate grossly abnormal subjects from the study. This scale also contains a concealed intelligence factor. Analysis of the personality testing results provided information that the subjects were essentially within normal limits on personality factors and

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that intelligence was distributed normally for the sample. All subjects were naive concerning the purposes of the experiments and no subject was used under more than one experimental condition. During an initial orientation, subjects were requested to perform to the best of their abilities. Cooperation was good and motivation to achieve during trials was excellent. The criterion task, compensatory tracking, was often described as interesting and challenging by the subjects.

### Experimental Design

Eight subjects were tested under each of the following conditions:

- Condition A: Red stroboscopic flicker, 10 cps plus direct suggestion.
- Condition B: White sound, 110 decibels ambient and direct suggestion.
- Condition C: Blue stroboscopic flicker, 10 cps plus direct suggestion.
- Condition D: Red stroboscopic flicker at 10 cps plus indirect suggestion.
- Condition E: White sound at 110 decibels ambient and indirect suggestion.
- Condition F: Blue stroboscopic flicker at 10 cps plus indirect suggestion.
- Condition G: Control; no stimulation.
- Condition H: Direct suggestion only.

Decisions on which subject would be assigned to a particular experimental condition were accomplished from a table of random numbers. Each subject was given four learning trials, eight stimulation trials, and two end trials. Each trial was of four minutes duration. Rest periods of four minutes were given between trials.

### Apparatus and Measurement

Psychomotor performance was measured by a Falcon constructed compensatory tracking device which consisted of joy stick control

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of an electronic dot driven erratically on a television type screen. The object of the task was for the subject to keep the dot in a 2-inch square in the middle of the screen. To add an element of cognition (negative transfer of training), the control apparatus was rotated 90 degrees so that when the subject pulled back on the joy stick, the dot moved laterally; when the subject moved the joy stick laterally, the electronic dot moved vertically. The rotation was made to the left in the case of right-handed subjects and to the right for left-handed subjects. Permanent records of time on and off target, in seconds, were kept on chart paper tracings produced by a Brush Recorder. All of the recording instruments were located in an observation room adjoining the experimental room and equipped with a one-way mirror.

An element of cognitive functioning was measured at the end of each trial by asking each individual subject to estimate the percentage of time he was successful in keeping the electronic dot inside of the target area. This estimate was then subtracted from the actual performance score. The difference, thus, represented a deviation from reality.

The flickering light source was a General Radio Strobotac delivering a light intensity of 4,000,000 candle power at source. This light was passed through blue or red gelatin filters with filter factors of approximately two. The strobotac was placed at a distance of four feet from the subjects eyes and directly over the compensatory tracking device screen.

The direct suggestion consisted of loud-speaker delivery of voice suggestion that arm stiffness and eye closure would take place and that drowsiness would occur. If these suggestions were ineffective for a particular subject then suggestions were given that bugs were crawling on his arms and neck. Peak ambient level of voice suggestion was controlled at 80 decibels.

White sound from records manufactured by Cook Laboratories, Stamford, Connecticut, was reproduced on magnetic tape and delivered by stereo tape recorder through high fidelity speakers to an ambient intensity of 110 decibels (Re 0.0002  $\mu$  bars). Intensity was measured by a General Radio, Type 1551-C Sound Level Meter.

EEG signals were recorded by an eight channel, Model D Modcraft Electroencephalograph for one-half of the subjects (N = 12) in this experiment.

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Indirect suggestion was given by informing the subject, just before the stimulation trials, that the stimulation might make him ill in some way.

### RESULTS:

#### Psychomotor Performance

That the subjects assigned to the eight experimental conditions were drawn from the same general population was indicated by an analysis of variance computed on psychomotor performance scores during four adaptation trials. No statistically significant differences were evinced.

The means and standard deviations of psychomotor performance for the eight experimental conditions are shown in Table 1. That these means differ significantly is demonstrated by the analysis of variance study summarized in Table 2. The significance of the mean differences have been tested by the *t* statistic and these data are reported in Table 3. Evidence of very significant differences ( $P < 0.001$ ) exist between the Control Condition (G) and all experimental conditions excepting Condition F (blue stroboscopic flicker, 10 cps, and indirect suggestion). In addition, very significant differences were found between Condition H (direct suggestion) and all other experimental conditions. Further, very significant differences occurred between experimental Conditions F and A, and E and A. A very significant difference ( $P < 0.01$ ) between F and B was measured.

#### Cognitive Functioning

The means and standard deviations representing the differences between the subject's estimated and actual time on target are shown in Table 4. That significant differences exist between these means is evinced in an analysis of variance study summarized in Table 5. The significance of the obtained mean differences is tested by the *t* statistic as shown in Table 6. Evidence of very significant differences ( $P < 0.001$ ) exist between the Control Condition (G) and all the experimental conditions. These deductions are clear and consistent.

Of particular interest is a comparison of Table 6 with Table 3. The superior disruptive power of direct suggestion alone, as listed in Column II of Table 3, has faded in Table 6. All conditions of stimulation have significantly interfered with cognition.

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Table 1. Psychomotor Performance Time on Target during Stimulation under Varying Experimental Conditions

Condition	M	SD
A	62.5	22.3
B	69.5	24.3
C	69.7	25.5
D	71.0	22.1
E	77.3	14.6
F	79.9	18.6
G	84.3	5.5
H	35.8	35.9

Table 2. Psychomotor Performance Analysis of Variance, Time on Target during Stimulation under Varying Experimental Conditions

Source	Sum of Squares	df	Variance Estimate	F
Rows (trials)	342.6699	7	48.9528	Insignificant
Columns (experimental conditions)	100,858.2324	7	14,408.3189	26.31 P = 0.001
Within Cells	245,333.125	448	547.6186	
Interaction	10,035.944	49	204.8152	Insignificant
TOTAL	356,569.998	511		

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Table 3. Psychomotor Performance Differences between Means under the Various Experimental Conditions as Measured by the t Statistic.

Experimental Conditions	A	B	C	D	E	F	G	H
Red Stroboscopic A Flicker, 10 cps and Direct Suggestion		1.68 p>.10	1.88 p=.07	2.27 p=.03	4.46 p<.001	3.04 p<.001	7.61 p<.001	4.88 p<.001
White Sound, B 110 dbs and Direct Suggestion			.23 p>.10	.47 p>.10	2.21 p=.03	2.85 p<.01	4.78 p<.001	5.04 p<.001
Blue Stroboscopic C Flicker, 10 cps and Direct Suggestion				.23 p>.10	1.89 p=.06	2.51 p=.02	4.25 p<.001	6.13 p<.001
Red Stroboscopic D Flicker, 10 cps and Indirect Suggestion					1.80 p=.06	2.47 p=.02	4.53 p=.001	6.59 p=.001
White Sound, E 110 dbs and Indirect Suggestion						1.01 p>.10	3.55 p<.001	8.40 p<.001
Blue Stroboscopic F Flicker, 10 cps and Indirect Suggestion							1.90 F=.06	8.63 p<.001
G Control								10.48 p<.001
H Direct Suggestion Only								

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Table 4. Differences between Estimated and Actual Time on Target under Varying Experimental Conditions

Condition	Mean	SD
A	18	12.5
B	24	24.3
C	21	21.8
D	19	16.7
E	20	14.5
F	25	18.1
G	5	2.9
H	31	31.9

Table 5. Cognitive Functioning Analysis of Variance: Differences between Estimated and Actual Time on Target under Varying Experimental Conditions

Source	Sum of Squares	df	Variance Estimate	F
Rows (Trials)	445.93	7	63.70	Insignificant
Columns (Experimental Conditions)	24,169.33	7	3,452.76	7.94
Within Cells	194,802.75	448	434.82	$p < 0.005$
Interaction	6,328.87	49	129.16	Insignificant
TOTAL	225,746.88	511		

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Table 6. Significance of Differences between Means as Measured by the t Statistic for Cognitive Functioning Scores

Experimental Conditions	A	B	C	D	E	F	G	H
A		.57 p>0.10	.95 p>0.10	.38 p>0.10	1.21 p>0.10	2.53 p<0.02	7.98 p<0.001	3.01 p<0.01
B			.73 p>0.10	1.35 p>0.10	1.12 p>0.10	0.26 p>0.10	6.17 p<0.001	1.19 p>0.10
C				0.58 p>0.10	0.30 p>0.10	1.12 p>0.10	5.78 p<0.001	2.15 p<0.05
D					0.36 p>0.10	1.94 p>0.10	6.54 p<0.001	2.64 p<0.02
E						1.71 p>0.10	8.06 p<0.001	2.49 p<0.02
F							8.66 p<0.001	1.30 p>0.10
G								6.45 p<0.001
H								

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Estimates of time on target are a non-spurious and stable measure. Vattano (1964) has conducted an experiment in which subjects were given distorted knowledge of tracking performance. His male subjects did not accept the distorted scores as factual. He concludes that the knowledge of results provided by visual and kinesthetic means (intrinsic) operates independently of knowledge of results provided by an external source. The stimuli in the Falcon experiment apparently interfered with the subjects evaluation of visual and kinesthetic cues.

The large standard deviations shown in Table 1 requires some discussion. The standard deviation for the Control Group (Condition G) gives an indication of only minor variation when stimulation is not applied. Under stimulation some individuals were not noticeably affected while the performance of others was severely reduced. This differential is reflected in the standard deviations computed under the conditions of stimulation.

A similar elevation in standard deviations occurs in Table 4 under all stimulation conditions while markedly reduced under the Control Condition. Again the variation is attributable to covering the range from individuals not affected to those severely affected.

### Respiration

Merely inspection of mean respiration data reveals no significant difference between any of the experimental conditions, all means falling between 16 and 16.4 per minute. It was discovered that those individuals threatened by the experimental conditions increased in respiration rate while those who were suggestible and gave positive reactions to suggestions of drowsiness gave decreased rates. The net effect was that each cancelled out the other and mean differences between stimulation and control conditions were nil. Variability did increase under stimulation conditions.

### Electroencephalograms

Analysis of EEG tracings reveals that two subjects reacted with severe abnormalities. These occurred during stimulation with red flicker. One subject responded with photomyoclonic jerks; another with abnormal slow wave activity. One subject evinced nominal breakdown of EEG rhythms under stimulation by blue flicker. Considerable evidence of photic driving was

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apparent during those conditions utilizing flicker. It is interesting to note that suggestible individuals produced records indicating drowsy, relaxed non-alertness. The use of frequency or automatic analysis would have been particularly helpful to measure the objective differences between white sound and photic flicker stimulation.

The analysis of EEG tracings was made without knowledge on the part of the neurologist of the stimulation conditions used.

### DISCUSSION:

It can readily be seen that the experimental stimulus most disruptive to efficient psychomotor performance and cognitive functioning in this experiment is suggestion delivered by the human voice, even though, in this case, the voice suggestions were delivered via microphone and loud-speaker. The words hypnotize and hypnosis were not mentioned to the experimental subjects but the direct suggestion followed rather standard hypnotic induction techniques.

Red flicker is the experimental condition that produced the severe EEG abnormalities previously discussed. Red flicker, when combined with direct suggestion, was also the double stimuli condition producing the largest decrement in psychomotor performance.

Neither flickering light nor white sound stimuli enhanced suggestibility; in fact, they apparently acted as distractions reducing the effectiveness of direct suggestion delivered singly. The forces operating here can only be answered by additional experimentation measuring reactions to these stimuli singly.

Subjective responses, spontaneously offered by subjects, concerning unpleasant effects of stimulation were most often reported when the stimulus was red stroboscopic flicker (tiredness, dizziness) and white sound (feelings of unreality, dissociation, and headache).

Individuals reacting most adversely to indirect suggestion were more overtly suspicious initially and gave evidence of feeling threatened by the stimuli. One individual subjected to indirect suggestion and red flicker terminated participation in the study, stating he felt both dizzy and confused.

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From this experiment it is concluded that:

1. The incidence of incapacitating abnormal cerebral response to photic flicker was 6.2 per cent. This occurred under experimental conditions utilizing red flashes.
2. Red flicker was more effective than blue in reducing subject performance.
3. Of the stimulating conditions employed, direct suggestion was the most effective in reducing subject efficiency in the protected environment of the laboratory.
4. Photic flicker does not enhance suggestibility in the protected environment of the laboratory.
5. White sound when delivered via loud-speaker at ambient intensities of 110 decibels does not act as a catalyst for hypnosis.
6. All stimuli employed reduced human efficiency.

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### GROUP EXPERIMENTATION

In order to verify that results obtained with individuals during the laboratory experiments could be obtained with groups performing military tasks, it was proposed that experimentation be conducted with small groups of military subjects using similar but modified stimuli. Accordingly a request was submitted to conduct group experiments with military subjects using light flickered on red smoke, light flickered on blue smoke, direct suggestion, and an unstimulated control condition. Air Force officials approved the use of direct suggestion with each group stimulated acting as its own control but did not, for good and sufficient reasons, authorize stimulation with flickered light.

#### PROCEDURES:

The setting for the experiments was a football field located on the main reservation at Eglin Air Force Base.

Experimenters and observers were housed in the press box at the top of the football stadium. Loud-speakers of the stadium public address system were adjusted so that the transmissions were clearly audible on the playing field. The experimental groups were subjected to hypnotic suggestions while engaged in activities between the two thirty-yard lines and within the near half of the field. Dr. H. H. McCord delivered the suggestions.

The experiments were conducted with three groups using four steps with each group.

#### Group 1

Step 1. Group One engaged in close order drill under the direction of its assigned officer. After drilling 10 minutes the group was halted in front of the stands and remained at parade rest for approximately one minute.

Step 2. Group One again engaged in close order drill but during this period they were subjected to pretaped hypnotic suggestions in an attempt to interfere with the drilling. After drilling 10 minutes the group was brought to a halt in front of the stands and remained at parade rest for two minutes.

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Step 3. Group One again engaged in close order drill for ten minutes without stimulation.

Step 4. Group One again engaged in close order drill. During this period they were subjected to live hypnotic suggestions transmitted over the public address system. Although their leader had been requested to drill for only 7 or 8 minutes during this step (because time was running short) he continued the drilling for twenty minutes.

### Group 2

Step 1. Group Two assembled and disassembled .45 caliber automatic pistols as the criterion task. The weapons were placed on a blanket and each subject knelt on the blanket while performing. Each subject disassembled and assembled his weapon twice, by the numbers, (components one at a time on verbal command) under direction of an NCO.

Step 2. Group Two again disassembled and assembled their weapons by the numbers. During this step they were subjected to pretaped suggestion.

Step 3. Group Two again disassembled and assembled their weapons but this time without the numbers, that is, each subject proceeded at his own speed, and without waiting for a step by step command from the NCO. This procedure was done twice.

Step 4. Group Two again disassembled and assembled their weapons, twice, and without the numbers. During this step the group was subjected to live suggestion.

### Group 3

The four steps used with Group One were replicated except that live suggestion was used in Step 2 and pretaped suggestion during Step 4.

Motion picture coverage was provided. Two cameras were used to provide complete scene coverage and closeups of individual responses.

Both live and pretaped suggestions were tape recorded, as given, and observer comments were superimposed on the new tape recording by Dr. H. L. Berridge of the Bioastronautics Division, Air Proving Ground Center.

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Professional evaluators included a psychiatrist and a psychologist from the USAF Hospital, Eglin Air Force Base, three psychologists from the Bioastronautics Division, Air Proving Ground Center, and one psychologist from the Psychological Weapons Research Facility, Detachment 4, Research and Technology Division.

### SUBJECTS:

Three groups of Air Force personnel were provided. Members of two of the three groups were volunteers. The composition of the three groups was varied to present different types of challenge to the experimenters.

Group 1 was made up of members of the Base Burial Drill Team No. 1 under the direction of the officer normally in charge of this group. This team was an experienced, 16-man drill team, that practices once a week in order to remain proficient. Tests using this group were conducted during one of the team's regularly scheduled practice periods.

Group 2 consisted of 4 volunteers from one flight of the Base Air Police Squadron. Their task was to disassemble and assemble .45 caliber pistols under the varying conditions.

Group 3 was made up of 12 volunteers under the direction of a non-commissioned officer (technical sergeant) from the Base Burial Drill Team who volunteered to serve as their group leader. This group, unlike Group 1, had never drilled together prior to this test.

### RESULTS AND DISCUSSION

No observable decrements in performance of either of the two marching groups were apparent. Execution of drill commands was substantially the same during the control and stimulation tests.

One happening, worthy of discussion, did occur. In the Group 1 tests, the officer-in-charge rather precisely timed Steps 1, 2, and 3 at ten minutes each. Before the beginning of Step 4, he was requested to cut this step to 7 or 8 minutes in the interest of conserving time. Significantly, however, although the three previous drill periods ran approximately ten minutes each, the fourth period which was supposed to be shortened, ran twenty minutes.

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It is possible that this was an accident on the part of the leader who was responsible for his own timing. This seems unlikely in view of his accuracy during the previous trials.

One explanation deserving consideration is the phenomenon of hypnotic time distortion. Cooper and Erickson (1954) deal with this in their book Time Distortion in Hypnosis. They point out that through hypnosis time can be made to pass rapidly. Kroger (1963) also describes this phenomenon.

Whether or not the drill officer distorted time is only speculated upon. He did more than double his allotment of time. The military implications of such behavior on the part of a commanding officer are self-evident.

One individual in Group 2 had difficulty in assembling his weapon during stimulation with live suggestion. During the unstimulated test in Step 3 he was one of the faster subjects and completed the task in less than four minutes. During the stimulation with live suggestion the same task required in excess of eight minutes. The evaluation of his performance by military authorities, including the professional evaluators was that the decrement in his performance was due to a faulty weapon, even though he had used the same weapon during both the unstimulated and stimulated tests.

However one treats these isolated incidents, the significant finding of the group experiments is that hypnotic suggestion failed to interfere in meaningful numbers with group performance in these tests. Additionally, at least fifty spectators were seated in the stands, observing the activity and hearing the suggestions without apparent effect on them with one possible exception.

The absence of interference with the group performance under the conditions tested is attributed to the lack of emotion in the test situation.

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### CONCLUSIONS AND RECOMMENDATIONS

Photic flicker incapacitates a significant number of normal humans. It also reduces efficiency in humans not fully incapacitated. These facts have been established in the literature and have been verified in these experiments with individual, normal human subjects. Its potential for use as a weapon is considerable.

It is believed that even more effective methods for inducing seizures by means of flickering lights can be developed. Available evidence supports this contention.

Man is a biorhythmic creature. Whenever natural biorhythms, such as heartbeat, respiration rate, or sleep cycles are interfered with, the organism may malfunction. Whenever natural rhythms become arrhythmic the organism does malfunction. The natural bioelectrical activity of the human brain is rhythmic. Photic driving consists of altering natural rhythms by rhythmic stimulation. Seizures consist of arrhythmic bioelectric discharges in the brain.

No studies have been reported in the literature of attempts to stimulate subjects with arrhythmic or aperiodic flicker. Dr. Mary A.B. Brazier (1957), one of the world's leading EEG neurologists, has speculated that aperiodic flicker, that is, varying flicker frequencies by very slight amounts in non-rhythmic fashion, may produce the kind of results here desired. The rationale is that by aperiodically stimulating the alpha bioelectric potentials at driving ranges, and activating neural pathways that normally initiate rhythmic driving, an intolerable reaction may be precipitated. This method should be tested in the laboratory.

The use of increasing and decreasing flicker frequencies requires additional study. Questions to be resolved are how far can photic driving, once initiated, be continued by increasing or decreasing the photic stimulation frequencies. The system most productive of severe results in the literature generally begins photic stimulation at three or four cycles per second and gradually increases the frequency until twenty or twenty-two cycles per second is reached. It was this method that resulted in the accidental death of four monkeys (De Arellano and Windle, 1961). It was also this method that produced seizures in 25.8% of 120 subjects (Brandt, Brandt, and

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Vollmand, 1961). In contrast, Alexander (1960) who used four strobolumes flickering at fixed rates for two and one-half hours with his subjects reported essentially negative results.

In keeping with the objective of practical weapons application and field use, one method of covering greater field areas with the same instrumentation is the employment of sweeping light beams. This may be particularly effective in wooded areas. Numerous accounts exist of seizures triggered by sunlight flickered through trees while riding along tree-lined roads. These are more frequent from Europe where tree-lined roads are more common than in the United States. Investigations of the effects of sweeping light beams in the laboratory should be conducted. Beams may be flickered through both periodic and aperiodic grids to determine methods of greatest effectiveness.

Additional experimental work with color is warranted. Since a differential has been found, a more precise definition of the best color for these purposes should be identified. Colors, carefully controlled for intensity, requiring additional study range from yellow through orange to red and even near infra red.

It is known that diffusing light near the eye is more disrupting than undiffused flicker. Laboratory investigations have generally employed opal glass or half ping-pong balls to obtain diffusion. In exploratory experiments during this study, light has been diffused by passing it through silk screens with highly effective results. Obviously these methods cannot be used in weaponry for field use. One potential method is diffusion of light by smoke. For laboratory use this would require nonstaining nontoxic smoke. Such a diffusing cloud has been produced in the Falcon laboratory by atomizing mineral oil and spraying it on a steel plate heated to 450 degrees Fahrenheit.

Additional work is required in identifying optimum light:dark ratios. There is evidence that utilizing a constant light source flickered by mechanical means is more effective than using stroboscopic flash with its short light portion of the light:dark ratio. Use of low intensity commercial photo-stimulators without concomitant use of drugs leads only to meager results.

Experimentation with groups located in wooded areas using methods found most effective in the laboratory is a logical follow-up. Several methods of delivery have been considered.

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Ultimately it is believed that delivery by aircraft is most promising. This may include air drops of parachuted flickering flares and flickering lights mounted in low-flying aircraft. The use of several aircraft flying predetermined formations such as one following another or flying side-by-side are possibilities. Large areas could be covered by this latter method if sweeping light beams should prove to be effective.

In actual use against enemy populations, restrictions experienced in the laboratory to guard against harmful intensities of stimulation to experimental subjects would not be a limiting factor. Intensities to the limit of capability could be used.

Efforts at successful application of suggestion techniques should not be abandoned. The literature abounds with instances amply demonstrating its power in situations where emotions are operating. The group experiments, as conducted, were devoid of emotional content. No attempts were made to implant cultural or religious emotions. In combat the element of fear runs high. If five per cent of an enemy force reacted to photic flicker with epileptic-type seizures, in a group setting it is believed that many more would become incapacitated through mob hysteria and panic behavior. Individuals reacting to flicker adversely, just short of seizures, that is, with nausea and dysphoria, may be particularly susceptible. The group experiments should be repeated with stimulation including both suggestion and flicker, but only after laboratory experiments identify the most effective method of delivering flicker.

Likewise, sounds should not be eliminated from consideration but more effective types of sound must be sought. Pure sounds have proved to be ineffective but potential appears to exist for complex sounds including white sound. Stimulation with higher intensities, but for shorter periods to avoid permanent ear damage, may provide prove productive.

In summary, these facts have been established by the literature search and experiments of this study:

1. At least five per cent of a normal population can be incapacitated by means of photic flicker. In addition, substantial decrements in psychomotor performance and cognitive functioning have been measured under conditions of photic flicker stimulation.

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2. Red flicker is more effective than blue in eliciting incapacitating reactions to flicker.
3. Direct hypnotic suggestion, when administered in the laboratory, is highly effective, but is less effective in group situations devoid of emotional overtones. Potential exists for the use of suggestion to trigger panic and hysteria when emotions such as fear, anxiety, or anger are present when the suggestion is applied.
4. The use of pure tones in auditory flutter when administered at 110 decibels is ineffective but some potential exists for the use of complex tones. White sound, combined with direct and indirect suggestion reduces psychomotor efficiency and cognitive functioning. Fluttering of white sound should be studied.
5. Strong evidence exists that even more effective methods for using photic flicker as a weapon can be found through further research. Areas requiring additional study include the use of aperiodic flicker, optimum light:dark ratios, changes of flicker frequency, extent of photic driving, effects of sweeping light beams, color variations, and practical means of diffusing light near the intended subject.

Further work should be done in each of these areas of demonstrated potential. When the most effective means for obtaining deleterious results from each of these methods of stimulation have been determined the stimuli should be combined, where possible, and studied. Upon completion of such studies meaningful recommendations for the fabrication of actual weapons can be formulated.

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## APPENDIX I

### COMPENSATORY TRACKING TASK SYSTEM

To provide a quantitative and objective measure of a subject's ability to perform under a variety of auditory, visual, and suggestive stimuli, a compensatory tracking task system requiring psychomotor activity was developed.

The tracking task system consists of two modified television receivers, a random motion generator, and a joy stick control.

The random motion generator consists of a cam driven by a geared-head clock motor at a rate of one revolution in two minutes. The irregular random surface of the cam operates two follower arms which are in turn connected to two potentiometers. Thus, a portion of the voltage impressed across the potentiometers is obtained which varies according to the surface of the cam being used. These two voltages are then amplified and impressed upon the deflection coils of the television receivers. The normal deflection voltages in the receiver are connected to a dummy yoke to maintain normal operation of the oscillator and provide the necessary high voltage for operation of the picture tubes.

To prevent burning of the picture tubes and to provide a more easily visible target, two sign waves differing in phase by 90 degrees are impressed upon the deflection coils along with the slowly varying random voltages from the cam. The end result is a circle about one-quarter inch in diameter, which moves randomly over the face of the two picture tubes.

The joy stick is connected to two potentiometers, one controlled by fore-and-aft motion, and the other by side-to-side motion of the stick. Electrically, these are connected in a similar fashion to the cam potentiometers described above, so that as the cam moves the circle away from the center of the screen, the joy stick can be operated to move it back. A small square (about two inches square) is marked off on the face of the television tube with tape, and the object is to keep the moving circle within the stationary square.

Additional circuitry is connected to the deflection coil amplifier, so that a relay opens when the circle is outside the square and closes when the circle is within the square.

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Additional circuitry is connected to the deflection coil amplifier, so that a relay opens when the circle is outside the square and closes when the circle is within the square. This relay is connected to the event recorder or a Brush two-channel recorder, so that a continuous record of the amount of time the subject is both on and off target is obtained.

One television set is placed in the experimental room and the other in an adjoining observation room. This provides the experimenter with a visual monitoring device on the subject's tracking performance. A one-way glass between the experimental and observation rooms also allows the experimenter to observe the subject during experimentation without the subject's awareness. This arrangement allows all stimuli and tracking task switches to be operated without uncontrolled distraction. A microphone in the observation room connected to ceiling speakers in the experimental room provides the experimenter with a means of communicating with the subject.

Accurate tracking task performance results were obtained from an event recorder.

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## APPENDIX II EXPLORATORY EXPERIMENTATION

Exploratory and pre-experimentation was conducted in the main psychological laboratory in Denver and in a branch laboratory in Irvington, New Jersey. The purpose of this activity was to delimit the number of experimental variables, to check and modify instrumentation, and to select erratic cams of appropriate difficulty levels for use with the psychomotor compensatory tracking device.

It is emphasized that these studies were purely exploratory in nature and neither tests of significance nor statements of probability are offered. Any conclusions drawn from them should be restricted to the formulation of hypotheses for testing in formal and controlled experiments.

### DENVER LABORATORY STUDIES:

#### Cam Number One

Nine male draftsmen and research assistants locally employed but not engaged in this project were given four learning trials on the psychomotor compensatory tracking device. Mean scores were computed for each trial. These personnel were then given single trials of the various stimuli in random fashion. For comparison purposes each subject acted as his own control; each subject's stimulation trial performances were compared with fourth learning trial performance. The results are tabulated in Table II-1.

#### Cam Number Two

Five subjects obtained from local college employment offices were given four psychomotor compensatory tracking learning trials followed by stimulation trials as indicated in Table II-2. Intensities of stimulation were increased over those used in Table II-1. Assignments to order of stimulation was random. Decrements in performance from those shown in Table II-1 have increased. It should be mentioned that Cam No. 2 was too erratic in certain phases of its cycle to permit mastery with learning.

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Table II-1. Exploratory Experiments, Cam No. 1, Psychomotor Compensatory Tracking Time on Target in Percentages, N = 9

Experimental Condition	Mean Score	Difference from 4th Learning Trial
1st Learning Trial	79	-14
2nd Learning Trial	91	- 2
3rd Learning Trial	91	- 2
4th Learning Trial	93	xx
White Sound, 70 db*	94	+ 1
White Sound, 90 db	93	0
Red Strob, 4 cps, $\frac{1}{2}$ million cp	93	0
Red Strob, 10 cps, $\frac{1}{2}$ million cp	97	+ 4
Red Strob, 17 cps, $\frac{1}{2}$ million cp	95	+ 2
Suggestion Only	90	- 3
White Strob, 1 million cp, 10 cps	92	- 1
White Strob, 1 million cp, 17 cps	97	+ 4
White Strob, 1 million cp, 10 cps and Suggestion	80	-13
'Ceiling Flicker, 4 cps	88	- 5
Ceiling Flicker, 10 cps	95	+ 2
Ceiling Flicker, 17 cps	93	0

\*Re 0.0002  $\mu$  bars.

'Three, 4-ft, 15-w, fluorescent bulbs fixed on lab ceiling.

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Table II-1. (Continued)

Experimental Condition	Mean Score	Difference from 4th Learning Trial
Sound 600 cps fluttered at 10 cps and Ceiling Flicker, 10 cps	95	+ 2
Sound 400-1200 cps, fluttered at 10 cps and Ceiling Flicker, 17 cps	94	+ 1
Sound 400-1200 cps, fluttered at 10 cps and Ceiling Flicker, 4 cps	96	+ 3
Sound, 400-1200 cps, fluttered at 4, 10, and 17 cps	97	+ 4
Blue Strob, 4 cps, 1/2 million cp	91	- 2
Blue Strob, 10 cps, 1/2 million cp	91	- 2
Blue Strob, 17 cps, 1/2 million cp	90	- 3
Green Strob, 4 cps, 1/2 million cp	94	+ 1
Green Strob, 10 cps, 1/2 million cp	92	- 1
Green Strob, 17 cps, 1/2 million cp	91	- 2
Red Strob, 4 cps, 1 million cp	88	- 5
Red Strob, 10 cps, 1 million cp	83	-10
Red Strob, 17 cps, 1 million cp	86	- 7
Blue Strob, 4 cps, 2 million cp	86	- 7
Blue Strob, 10 cps, 2 million cp	83	-10
Red Strob, 4 cps, 2 million cp	85	- 8
Red Strob, 10 cps, 2 million cp	75	-17
Red Strob, 17 cps, 2 million cp	80	-13

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Table 11-2. Exploratory Experiments, Cam No. 2 Psychomotor Compensatory Tracking Time on Target in Percentages, N = 5

Experimental Condition	Mean Score	Difference from 4th Learning Trial
1st Learning Trial	61	-16
2nd Learning Trial	73	- 4
3rd Learning Trial	72	- 5
4th Learning Trial	77	xx
White Sound 100 db	78	+ 1
Red Strob, 4 cps, 2 million cp	57	-20
Red Strob, 10 cps, 2 million cp	49	-26
Red Strob, 17 cps, 2 million cp	59	-18
Blue Strob, 4 cps, 2 million cp	71	- 6
Blue Strob, 10 cps, 2 million cp	62	-15
Blue Strob, 17 cps, 2 million cp	69	- 8
Sound Flutter, 400-1200 cps, 100 db @ 4 cps	78	+ 1
Sound Flutter, 400-1200 cps, 100 db @ 10 cps	79	+ 2
Sound Flutter, 400-1200 cps, 100 db @ 17 cps	79	+ 2
Suggestion Only	66	-11

\*Re 0.0002  $\mu$  bars.

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### Cam Number Three

Three subjects obtained from the Colorado State Employment Service were given four psychomotor compensatory tracking learning trials followed by stimulation trials as indicated in Table II-3. Assignments to order of stimulation was random. Cam No. 3 was selected for use in formal experimentation. This cam provided an initially desirable difficulty level and gave evidence of an orderly learning curve. Results are summarized in Table II-3.

### Diffused Flicker

Three subjects were exposed to photic flicker of up to four million candle power with the light diffused by silk screens placed four inches from the eyes. Two screens were used, one of white and one of red. It was impossible to measure tracking performance under these conditions because the target could not be seen during stimulation with such intense light, even though the target was clearly visible through the silk screens when the flicker was not turned on. Flicker rates were begun at 4 cps and slowly increased to 11 cps at 4 million candle power. The intensity was then set at 1-1/2 million candle power and flicker rates slowly increased to 22 cps. Rates were then decreased back down to 11 cps, intensity changed to 4 million candle power and rates slowly decreased to 4 cps. Each subject was stimulated twice, once with the white silk screen being used and once with the red screen. EEG tracings were taken with two of the three subjects.

All three subjects reported vivid visual hallucinations under this stimulation. Closing the eyes intensified the hallucinations. Two subjects became nauseated, one to the extent that several hours were required for recovery. The third subject reported feelings of dissociation. EEG evidence was that severe alpha blocking occurred in the subject reporting nausea and downward driving in the subject reporting dissociation. Reactions were more severe under conditions of red stimulation. Formal experimentation with this type of stimulation is warranted.

### IRVINGTON LAB STUDIES:

Forty subjects between the ages of 21 and 30 were recruited from the Newark College of Engineering and local medical technology schools.



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Table 11-3. Exploratory Experiments, Cam No. 3, Psychomotor Compensator, Tracking Time on Target in Percentages, N = 3

Experimental Condition	Mean Score	Difference from 4th Learning Trial
1st Learning Trial	59	-23
2nd Learning Trial	66	-16
3rd Learning Trial	77	- 5
4th Learning Trial	82	xx
White Sound, 110 db*	83	+ 1
White Sound and Direct Suggestion	74	- 8
'Red Strob, 10 cps and Direct Suggestion	60	-22
'Red Strob, 10 cps and Indirect Suggestion	73	- 9
'Blue Strob, 10 cps and Suggestion	74	- 8
'Blue Strob, 10 cps and Indirect Suggestion	80	- 2
Suggestion Only	67	-15
Sound Flutter, 400-1200 cps @ 4, 10, and 17 cps	85	+ 3

\*Pp 0.0002  $\mu$  bars.

'2 million candle power.

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Instrumentation consisted of a Medcraft 8-channel electroencephalograph, a photo-stimulating device, an audio-stimulating device engineered to deliver white sound, a specially-adapted commercial projector, a strip chart recorder, a signal decoder, and two tape recorders on which instructions and stimuli were programmed.

The photo-stimulating device consisted of a General Radio Strobotac mounted to the rear of a fiberboard box. The neck of the strobotac reflector holder fit into a metal sleeve which extended into an opening in the rear of the box. Slots provided a means for use of color filters and Fiberglas light attenuators. An opening in the front of the box held a transparent disc, set vertically and mounted on edge bearings to permit rotation without use of a central axis. The transparent disc was driven by a small electric motor at 30 rpm. A multiple spiral disc was superimposed partially over and surrounding the transparent disc. This arrangement permitted the use of various colors and designs, including backlighted color.

Instrumentation for the cognitive test consisted of a commercial slide projector which flashed simple arithmetic (subtraction) problems onto a black screen fixed directly above the photo-stimulating device. The slides were made on color film so that the appearance of the equations on the screen was white on black, with a minimum of stray light to provide distraction. Frequency was programmed and remotely controlled by a Webcor Squire tape recorder located outside the experimental room. Sound signals from the programmed tape were fed into a decoder which activated the charge mechanism of the projector. Permanent records were obtained on a strip chart marked by a bridge-type recording meter showing the presentation of a projected material and the subject's reactions as obtained from a hand-controlled switch.

Three slide magazines were used, with 64 slides in each in random order. While the slides in each magazine were the same, they were placed in the magazine in a different random sequence, and different error equations were used in each series. The magazines were used in rotating order - 1, 2, 3, 1, 2, 3, etc. - in order to prevent the subject from memorizing the order of the errors.

A 2-way intercom was used to maintain contact with the subject. Observation was possible via a one-way mirror.

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The intensity of light delivered by the strobotac was four million candle power at the source. The red and blue filters attenuated the light by a filter factor of approximately two. Further attenuation occurred because of the distance of the subject from the light source, which was 36 inches. The intensity of light at the retina was estimated at approximately one million candle power.

The white sound was generated by audio-analgesia equipment called the Auralgesia, delivered through two loud-speakers at an ambient intensity of 110 decibels (Re 0.0002  $\mu$  bars) in the experimental room.

The following instructions were pre-recorded and presented to each subject.

1. Instructions Before the First Learning Trial: "Make yourself comfortable now. Place your feet flat on the floor, your left arm on the arm of the chair, and your right hand resting on the switch. Keep your eyes on the screen ahead of you. When the experiment begins, there will be flashes on the screen simple arithmetic problems and their answers. These will be problems in subtraction. Some of these answers will be incorrect. When you see what appears to be a wrong answer, quickly depress the switch and quickly release it. (Repeat last sentence.) The experiment is about to begin."
2. Instructions Before Second, Third, and Fourth Learning Trials: "Now the next trial is about to begin. Assume the same position, with your feet flat on the floor, your left arm on the arm of the chair and your right on the switch. When you believe an answer to be wrong, quickly depress the switch and quickly release it. The experiment is about to begin."
3. Instructions at End of Each Trial: "There will now be a one-minute rest period. Just relax and take it easy."
4. Instructions Before Stimulation Trial No. 5: "In the following experiment you will be required to do the same thing as before--that is, perform your task as accurately as possible and indicate errors by depressing the switch under your right hand. Now, in addition to the previous conditions, you will be exposed to flashes of light and a steady noise."

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Direct Pre-Test Suggestion, 8 Subjects: "We will now begin our next experiment. During this experiment, you will experience several or all of the following reactions. You will not be able to control the twitching in your fingers and your hands. You will depress the switch uncontrollably and at the wrong time. The material on the screen will jump, become muddled and confused, so that you will not understand it. Your eyes will smart. They will tear and blink, causing blurring and distortion of your vision. You may indeed find the effects so overpowering that you will become increasingly drowsy and sleepy. You will become dizzy, confused, and you will not be able to think straight. The experiment is about to begin."

Indirect Pre-Test Suggestion, 8 Subjects: "In the next experiment, you will receive subliminal suggestion by way of sight and sound. You have no doubt heard of subliminal suggestion in connection with tests conducted in movie theaters and on television. These tests showed that, when a message is flashed on the screen at a speed too fast for the eye to see and the conscious mind to grasp, the subconscious does see it nonetheless, and, since the message by-passes the critical conscious, it is uncritically carried out by the subconscious. In this case, you will receive subliminal suggestion through two channels. There is a special device behind the filter on the stroboscope which will project visual subliminal messages. And, a tape recorder will deliver similar messages through your sense of hearing. The taped messages will be delivered at twice the speed at which they were recorded. This distortion will prevent the conscious mind from understanding the messages--but the subconscious will unscramble and grasp the message. The recorded messages will be further distorted by the white noise. Our purpose in this experiment is to discover how much your performance with the arithmetic problems will be disrupted by the subliminal suggestion--how many more errors you will make--how difficult it will be for you to control the erratic movements of your fingers on the switch, so that you will depress it uncontrollably and at the wrong time--how much confusion you will feel, so that you will be unable to recognize the errors, or will see errors where none exist. The experiment is about to begin."

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During stimulation, the taped material, recorded at 3-3/4 ips and played back at 7-1/2 ips, was audible through the white sound, creating a rather weird sound effect. Every fifteen seconds, the volume of white sound was turned down manually for three seconds, so that the distorted taped material blared forth. Of course, there were no visual messages, but the replacement of the filter with another was intended to leave the impression that some unusual device was operative. Naturally, distorted auditory material is no more intelligible to the subconscious than it is to the conscious mind. It is in this sense that the suggestions administered just prior to the trial were indirect (permissive) suggestions.

Direct Suggestion During Exposure to Stimuli, 8 Subjects: The direct suggestions delivered during exposure to the stimuli were along the same lines as the direct pre-test suggestions, except that they were repeated in a variety of ways. Stress was placed on the uncontrollable movements of the hands and fingers, the twitching, etc., on the blurring and jumping of the numbers on the screen, on the confusion and disorientation of the subject, on the blurring and distortion of vision, on the tendency to delay error reaction, on smarting of the eyes and on drowsiness, etc. The suggestions were delivered in an excited, hurried manner, intended to cause anxiety and stress. While the suggestions ran continuously during the visual and auditory stimulation, the white sound was manually turned off every five seconds, so that the suggestions were audible for the next five seconds; thus white sound and suggestion alternated at five second intervals.

By-Play Suggestion, 16 Subjects: An indirect "by-play" suggestion technique was employed in which two experimenters thoroughly rehearsed a procedure consisting of acting out a situation which indirectly suggested to the subject that he was wired in such a manner that he would be prevented from functioning normally in carrying out his task. No instructions or explanations were directed to the subject himself; the experimenters spoke to each other in cryptic monosyllables. One experimenter adjusted electrodes on the subject's wrist and fingers while the other took "readings" outside the room. Frontal, temporal, parietal, and occipital "resistances"

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were taken and recorded, with one experimenter holding EEG leads to various parts of the subject's scalp while the other took the "readings". Using other equipment, "voltages" were checked and "guards" were placed. "Impulses" to fingers were "crossed" in such a way that the impression was left that disruption of motor function was inevitable and a foregone conclusion. Only at one point was a direct suggestion made to the subject, and that was to the effect that he should not hesitate to terminate the experiment by speaking into the intercom if he felt a need to do so, or if anything that happened "was too disturbing". Also "checked" were flicker frequencies and db levels. Dials were turned, switches flicked audibly and in other ways the by-play was intended to produce anxiety and anticipation of disruption effects. Since many of the subjects were engineering students and presumably sophisticated, it was deemed advisable to try this procedure out on a medical doctor, to determine whether anything "phony" could be detected. The physician accepted the procedure without any question of its credibility and authenticity.

Following the by-play trial, an additional trial was run. In this trial, the subject was "taken into our confidence" and told "just what we were looking for". He was told that, in the previous trial, he had been "wired in" for certain reactions, but that the electrical "contact" had not yet been made--that the trial had just been a "dry run" to check the equipment. In the next trial the "contact" would be made and he was told just what was expected. Certain "electrical adjustments and connections" had been made to cause his fingers to lose "coordination". It was merely the purpose of the experiment to discover at which points and at what intervals the "uncontrollable inappropriate reactions" would occur. The equipment was "double-checked" before the trial began.

The results obtained in these exploratory experiments are summarized in Table II-4. Since this table reports mean errors the positive scores represent error increase.

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Table II-4. Mean Error Response in Detecting Simple False Equations

Experimental Condition	N	Mean Error	Difference from 4th Learning Trial
1st 3 Learning Trials	40	5.3	+1.5
4th Learning Trial	40	3.8	xx
Condition A: Visual and Auditory Stimuli	40	5.1	+1.3
Condition A Plus Direct Pretest Suggestion	8	4.5	+0.7
Condition A Plus Indirect Pretest Suggestion	8	4.6	+0.8
Condition A Plus Indirect By-Play	16	6.8	+3.0
Condition A Plus Direct By-Play	16	6.0	+2.2
End Trial	40	3.7	-0.1

ATL-TDR-64-61

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13. ABSTRACT The purpose for this research was to investigate the potential of flickering light, sound, and suggestion, singly and in combination, for use in psychological weaponry. A search of the pertinent literature was performed followed by individual and group experimentation. The results obtained demonstrate that potential exists for the use of photic flicker as a weapon. Suggestion was effective in the laboratory but ineffective with military groups in an emotional setting. Further experimentation with photic flicker singly and in combination with suggestion is warranted. Recommendations for further specific research are provided.		

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3 August 1998

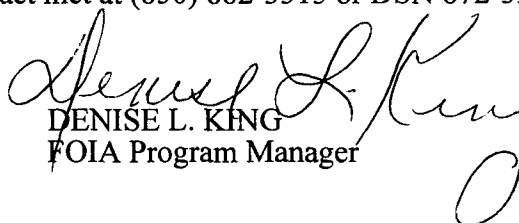
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MEMORANDUM FOR: DTIC-RSM (FOIA 98-97)

FROM: AFTC/IMDF (FOIA OFFICE)  
207 W. D Ave, Suite 214  
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SUBJECT: Change in the Distribution Statements/Export Warning Statements of two  
Technical Reports requested under the Freedom of Information  
Act (FOIA)

1. In accordance with DoD Directive 5230-25, a review of two technical reports was conducted by this Air Force Activity, in response to a FOIA request referred to this agency by the Air Force Pentagon FOIA office.
2. The review by the Air Force Research Laboratory (AFRL/MNOC), resulted in a determination that the reports AD 355 592 and AD 371 636 are no longer subject to U.S. Export Control Laws and does not disclose Critical Technology.
3. Request your records be mark accordingly to indicate these changes. I have provided at attachment 2, copies of the reviewing officials comments, should you need to contact them or you require additional background information.
4. If you have any questions, please contact met at (850) 882-3315 or DSN 872-3315.

  
DENISE L. KING  
FOIA Program Manager

Attachments:

1. FOIA Request Ltr, undated, w/Encl. Case
2. AFRL/MNN, Ltr's, 15 Jul 98
3. Your Ltr, 31 Mar 98

ERRATA



DEPARTMENT OF THE AIR FORCE  
AIR FORCE RESEARCH LABORATORY (AFMC)  
EGLIN AIR FORCE BASE, FLORIDA

15 July 1998

MEMORANDUM FOR AFRL/MNOC

ERRATA

FROM: AFRL/MNN


SUBJECT: FOIA Case File Processing Action (AD-355592)

1. I have reviewed subject FOIA request and determined per DoD Directive 5230.25 that this information is releasable to the requester. After careful reading of the Technical Report (TR) entitled "The Development of Weapons for Psychological Warfare," I believe that while said TR is under control of the Department of Defense and has potential military application, it is not subject to U.S. export control laws and does not disclose critical technology.

2. The Tech Report was published in October 1964 and minimally classified at the Confidential level. The basic premise is that flickering lights, sound and/or suggestion might have applicability as a weapon. In the intervening 30 years, all three have come to be commonly accepted as potential "weapons" – in that they can be used to modify the behavior of a potential enemy or criminal. Flickering lights have recently been featured on Discovery as disabling technology for law enforcement officials. A public debate is on-going on the Internet about the use of "infrasound" as a non-lethal technology which is several generations beyond anything described in this TR. And finally, the use of suggestions as a means of influencing group behavior is a well known tenet of Psychological Operations. Therefore, there is no apparent cogent reason for denying access.

3. Questions may be addressed to the undersigned at 882-8276.

ERRATA

  
PAULETTE M. RISHER  
Corporate Development Officer



DEPARTMENT OF THE AIR FORCE  
AIR FORCE RESEARCH LABORATORY (AFMC)  
EGLIN AIR FORCE BASE, FLORIDA

15 July 1998

MEMORANDUM FOR AFRL/MNOC

ERRATA

FROM: AFRL/MNN

SUBJECT: FOIA Case File Processing Action (AD 371 636)

1. For the second time in 6 months, I have reviewed subject Technical Report (TR) and determined per DoD Directive 5230.25 that this information is releasable to the requester. After careful reading of the TR entitled "Investigation of Psychological Effects of Non-Nuclear Weapons for Limited War (U)", I believe that while said TR is under control of the Department of Defense and has potential military application, it is not subject to U.S. export control laws and does not disclose critical technology.

2. The TR contains only contains Volume I of the study and only the third section, "Applications, Conclusions, and Recommendations" (along with its synopsis and DTIC Summary) were originally classified. Most of the conclusions are now available in open literature including the Army's Field Manual 11-5, *Leaders' Manual for Combat Stress Control*. The experimental design proposed (but never carried out) for a long-term follow-on study would today be prohibited under the rules of "informed consent" that have become normative in psychological research. Finally, the formerly classified section of the TR directly cites a University of Chicago study called "Project Camelot" which is available on the World Wide Web at [http://www.parascope.com/articles/0297\\_congorpt.htm](http://www.parascope.com/articles/0297_congorpt.htm). Therefore, there is no apparent cogent reason for denying access.

3. Questions may be addressed to the undersigned at 882-8276.

ERRATA

PAULETTE M. RISHER  
Corporate Development Officer